Availability of Pediatric Inpatient Services in the United States

Anna M. Cushing, MD,a,b Emily M. Bucholz, MD, PhD, MPH,c,d Alyna T. Chien, MD, MS,a,e Daniel A. Rauch, MD,e,f Kenneth A. Michelson, MD, MPHc,g

abstract

OBJECTIVES: We sought to evaluate trends in pediatric inpatient unit capacity and access and to measure pediatric inpatient unit closures across the United States.

METHODS: We performed a retrospective study of 4720 US hospitals using the 2008–2018 American Hospital Association survey. We used linear regression to describe trends in pediatric inpatient unit and PICU capacity. We compared trends in pediatric inpatient days and bed counts by state. We examined changes in access to care by calculating distance to the nearest pediatric inpatient services by census block group. We analyzed hospital characteristics associated with pediatric inpatient unit closure in a survival model.

RESULTS: Pediatric inpatient units decreased by 19.1% (34 units per year; 95% confidence interval [CI] 31 to 37), and pediatric inpatient unit beds decreased by 11.8% (407 beds per year; 95% CI 347 to 468). PICU beds increased by 16.0% (66.9 beds per year; 95% CI 53 to 81), primarily at children’s hospitals. Rural areas experienced steeper proportional declines in pediatric inpatient unit beds (−26.1% vs −10.0%). Most states experienced decreases in both pediatric inpatient unit beds (median state −18.5%) and pediatric inpatient days (median state −10.0%). Nearly one-quarter of US children experienced an increase in distance to their nearest pediatric inpatient unit. Low-volume pediatric units and those without an associated PICU were at highest risk of closing.

CONCLUSIONS: Pediatric inpatient unit capacity is decreasing in the United States. Access to inpatient care is declining for many children, particularly those in rural areas. PICU beds are increasing, primarily at large children’s hospitals. Policy and surge planning improvements may be needed to mitigate the effects of these changes.

WHAT’S KNOWN ON THIS SUBJECT: As pediatric care has become regionalized and pediatric hospitalizations have declined, there are reports of community hospitals closing or decreasing pediatric services. It is not clear to what extent pediatric inpatient unit capacity and access has decreased across the United States.

WHAT THIS STUDY ADDS: Pediatric inpatient unit capacity has declined in the United States. Large geographic differences exist in the availability of pediatric services, and rural areas have experienced larger decreases in pediatric inpatient unit capacity. Low-volume pediatric units are at highest risk of closing.

General hospitals accounted for 70% of the nearly 2 million pediatric hospitalizations in 2012. Because there are relatively few children’s hospitals, children who are ill rely on access to care at these community hospitals. Pediatric subspecialty and surgical care has become increasingly regionalized to freestanding children’s hospitals and academic centers, improving outcomes for complex conditions and for the >90 000 children each year requiring intensive care. However, regionalization is also associated with declines in general hospitals’ provision of definitive acute care and increased inpatient referrals for common conditions. Although there are anecdotal reports of such trends, the extent and geographic distribution of these changes is unclear.

Access to inpatient care depends on both pediatric bed capacity and proximity to pediatric inpatient services. Capacity is particularly important during times of increased bed demand, such as epidemics or disasters. Pediatric disaster simulations predict increases in mortality and the need to lower standards of care during disaster-related surges of patients with acute and critical illness. Although such acute surges are rare, they are also unpredictable, as the coronavirus disease 2019 pandemic has revealed. Inpatient unit bed shortages lead to emergency department crowding and decreased availability, safety, and quality of care. Because of dual forces of regionalization and decreasing hospitalizations, pediatric inpatient unit capacity may be decreasing, and community hospitals may be at risk for pediatric inpatient unit closures. Although there are anecdotal reports of such trends, the extent and geographic distribution of these changes is unclear.

The objective of this study was to evaluate recent trends in pediatric inpatient unit capacity and access to pediatric inpatient services in the United States. Understanding these trends will allow for improved pediatric resource allocation and bed planning to manage pediatric inpatient surges and ensure adequate inpatient care remains available for all children.

METHODS

Data Sources

We performed a retrospective study of general and pediatric hospitals in the United States. We obtained bed counts and hospital demographics from the 2008–2018 American Hospital Association (AHA) Annual Survey. Financial data were obtained from the 2008–2018 Healthcare Cost Report Information System from the Centers for Medicare & Medicaid Services. State hospitalization counts were obtained from the 2008–2016 HCUPnet. Population counts were obtained from 2009–2018 American Community Survey 5-year estimates. The Boston local institutional review board declared the study exempt from further review.

The AHA survey is a self-report survey sent annually to all US hospitals. Hospitals appears in the AHA survey regardless of whether a survey response was submitted and are assigned a longitudinal identifier. We repaired hospital identifiers when the identifier changed because of mergers (n = 28; 0.4%) or survey identifier changes (n = 40; 0.6%). We included hospitals that self-identified as general or pediatric medical-surgical hospitals. We excluded hospitals that were nonresponders to the AHA survey for all study years and those that self-identified as a facility solely dedicated to care of subspecialty, surgical, long-term care, or rehabilitation patients in one or more data years. We also excluded hospitals that never reported having any general or pediatric medical beds during the study period because we believed such hospitals were unlikely to provide inpatient medical care.

Outcome Measures and Variable Definitions

The first outcome was the number of pediatric inpatient units, defined as a hospital indicating that it had one or more pediatric inpatient medical beds. Other outcomes included the presence of PICU services (excluding neonatal intensive care), pediatric inpatient unit bed counts, PICU bed counts, distance to closest pediatric inpatient unit and PICU services, and openings and closures of pediatric inpatient units. All bed counts pertained to staffed beds.

We defined a pediatric inpatient unit opening as the first of two consecutive years a hospital reported having pediatric inpatient unit beds. We defined closure as the first of two consecutive years a hospital reported 0 pediatric inpatient unit beds after previously being open. We defined hospital openings and closures on the basis of AHA documentation, supported by manual corroboration by using press releases or news reports. For the 5 discrepancies between AHA documentation and corroboration, we reached a consensus determination.

Hospitals’ bed counts were missing in 16.3% of observations. We imputed missing counts by carrying forward the previous observation. For missing bed counts at the beginning of the study period, we carried the first nonmissing observation backward.

Hospital Demographics

Hospital demographics, including location, ownership, Medicaid use quartile (among all patients), and
total adult and pediatric hospital beds, were obtained from the AHA survey in the first year available for each hospital. We defined teaching hospitals, children’s hospitals, and sole community hospitals or critical access hospitals as those that ever qualified as such during the study.\textsuperscript{23,24} Financial data included profitability, defined as quartile of total profit margin, and disproportionate share hospital (DSH) status, a measure of being a community safety net hospital.\textsuperscript{26} We defined patients’ and hospitals’ urbanicity by 2010 census tract–based rural-urban commuting area codes,\textsuperscript{27,28} categorized as urban, micropolitan, or rural.\textsuperscript{29}

**Data Analysis**

**Trends in Prevalence of Pediatric Services**

We used bivariate comparisons to test which hospital characteristics were associated with ever having pediatric beds. We estimated changes over time in pediatric inpatient unit and PICU beds and number of open pediatric inpatient units or PICUs using linear regression. We repeated these analyses for general versus children’s hospitals and across urban-rural designations to investigate how shifts in capacity varied by hospital mission or location.

To characterize bed capacity and use, we plotted pediatric inpatient unit beds and number of inpatient days for children aged 1 to 17 years. We determined median per-state decreases in inpatient days and inpatient unit beds.

**Access to Pediatric Inpatient Care**

To determine how difficult it might be for a family to access care, we calculated great circle distance from the center of each census block group to the nearest pediatric inpatient unit and PICU. We compared distance to the nearest pediatric inpatient unit annually by census block group with that in 2009 for all children and stratified by patient urbanicity. We constructed maps revealing the nearest inpatient unit and PICU, highlighting areas where access changes occurred, defined as an increase or decrease in distance to the nearest unit by using thresholds of 5, 10, 20, and 50 miles.

Because families often choose to visit the nearest hospital during illness, we calculated the percentage of children whose nearest hospital contained an open pediatric inpatient unit in 2009 and 2018. To understand regional differences in pediatric capacity, we determined pediatric inpatient unit and PICU beds per capita in each state.

**Pediatric Inpatient Unit Closures**

Pediatric inpatient unit openings and closures were plotted yearly by whether the entire hospital or inpatient unit only closed. Using a Cox proportional hazards model, we assessed time to inpatient unit closure among hospitals that remained open through 2018. We theorized the following hospital characteristics could predict time to closure: teaching status, ownership, urbanicity, critical access hospital or sole community hospital designation, Medicaid utilization quartile, profitability, DSH status, pediatric inpatient unit bed count quartile (in the first year an inpatient unit was reported), and presence of a PICU. Children’s hospital designation was not included in the multivariable model because it perfectly predicted nonclosure. For each characteristic, we also tested the unadjusted association with inpatient unit closure.

**Sensitivity Analyses**

We performed sensitivity analyses to assess the possibility of imputation biasing our conclusions. First, we compared characteristics of hospitals with and without any missing bed counts; differences in characteristics would suggest bed counts were not missing at random and would underscore the importance of imputation. Second, to assess overestimation from carrying forward bed counts, we reexamined the prevalence analysis using linear interpolation for bed count gaps and separately carrying backward bed counts (or forward for missing counts at the end of the study). Finally, we compared pediatric inpatient unit beds per hospital and proportion of hospitals with inpatient units using 3 different imputation approaches: no imputation, strict imputation (filling in bed counts only when flanked before and after the missing period by an equivalent bed count), and complete imputation (the approach used in the main analysis).

**Statistics**

For bivariate comparisons, we used exact and nonparametric statistics. For all significance testing and models, we used a two-sided \( \alpha \) of .05 and reported 95% confidence intervals (CIs). We used linear regression to fit changes in continuous variable outcomes. The statistical analysis was performed in R version 4.0.0 (R Foundation for Statistical Computing, Vienna, Austria).

**RESULTS**

During the study, 5221 hospitals met criteria for inclusion. Of these, we analyzed 4720 hospitals. We excluded 232 (4.4%) hospitals for never responding to the survey; 261 (5.0%) hospitals for self-identifying as a subspecialty, psychiatric, surgical, long-term care, or rehabilitation facility; and 8 (0.2%) hospitals for reporting 0 medical beds during the study.
The majority of analyzed hospitals were nonteaching (87.4%), nonprofit (59.8%), urban (56.5%), and non–children’s hospitals (98.6%) (Supplemental Table 3). Of analyzed hospitals, 42.6% ever reported having a pediatric inpatient unit. Hospitals that ever had a pediatric unit were more likely to be teaching (17.9% vs 8.7%), nonprofit (67.8% vs 53.9%), urban (68.2% vs 47.8%), DSHs (73.0% vs 44.5%), and in the top half of Medicaid use (58.3% vs 43.8%) and were more likely to have higher total hospital capacity (median 191.0 vs 64.0 beds) (Supplemental Table 4).

**Trends in Prevalence of Pediatric Services**

Pediatric inpatient units decreased by 19.1% from 1753 in 2008 (38.2% of all open hospitals) to 1418 (32.1%) in 2018, a decline of 34.2 units per year (95% CI 31 to 37) (Table 1). Pediatric inpatient unit beds decreased by 11.8%, from 31 171 in 2008 to 27 496 in 2018, a decrease of 407 beds per year (95% CI 347 to 468). The number of PICUs was stable, with 358 (7.8%) in 2008 and 349 (7.9%) in 2018. PICU beds increased by 66.9 beds per year (95% CI 53 to 81) from 4646 in 2008 to 5388 in 2018.

Pediatric beds became more concentrated at children’s hospitals. Inpatient unit beds increased 12.1% (63.5 beds per year; 95% CI 27 to 100) at children’s hospitals and decreased 18.4% (471 beds per year; 95% CI 442 to 500) at general hospitals (Supplemental Table 5). The share of inpatient unit beds within children’s hospitals increased from 21.5% to 27.4%. During this time, PICU beds increased 46.4% (53.4 beds per year; 95% CI 44 to 62) at children’s hospitals and increased 4.9% (13.5 beds per year; 95% CI 4 to 23) at general hospitals. The share of PICU beds within children’s hospitals increased from 26.7% to 33.7%.

Rural areas experienced steeper declines in pediatric services, with a 24.2% decline (6.1 units per year; 95% CI 4 to 8) in pediatric inpatient units and a 26.1% decline (26.4 beds per year; 95% CI 17 to 36) in pediatric inpatient unit beds (Supplemental Table 5). By contrast, in urban areas, the number of pediatric inpatient units decreased by 18.6% (21.8 units per year; 95% CI 20 to 24) and the number of pediatric inpatient unit beds decreased by 10.0% (299 beds per year; 95% CI 250 to 347).

For 27 of 36 (75%) states with available use data, both the number of pediatric inpatient days and pediatric inpatient unit beds decreased (Fig 1). The median per-state decrease in inpatient days was 18.5%, and the median per-state decrease in beds was 10.0%. Eighteen states experienced a greater proportional decrease in pediatric inpatient days than beds. Pediatric inpatient days increased for 5 states (CO, MN, MO, ND, and UT), and pediatric inpatient unit beds increased in 5 states (HI, KY, OK, SC, and UT).

**Access to Pediatric Inpatient Care**

Among 73.4 million US children in 2018, 18.2 million (24.7%) experienced an increase in distance and 4.7 million (6.4%) experienced a decrease in distance to the nearest pediatric inpatient unit (Fig 2). Children living in micropolitan or rural locations experienced larger changes in distance than those living in urban areas. An increase in distance to the nearest PICU occurred for 7.2 million (9.8%) children and a decrease in distance to the nearest PICU occurred for 8.3 million (11.2%) children. Distances to the nearest pediatric inpatient units and PICUs in 2018 are shown in Fig 3. The distance to the nearest inpatient unit increased by >5 miles for 7.3 million children, >10 miles for 3.5 million children, >20 miles for 1.3 million children, >50 miles for 136 808 children, and >100 miles for 47 947 children. The distances to the nearest PICU increased by >5 miles for 2.4 million children, >10 miles for 1.6 million children.

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TABLE 1 Trends in Pediatric Inpatient Unit and PICU Counts, With Trends in Pediatric Inpatient Unit and PICU Beds

<table>
<thead>
<tr>
<th>Year</th>
<th>Analyzed Hospitals</th>
<th>Hospitals With Pediatric Units, n (%)</th>
<th>Change in Pediatric Units, %a</th>
<th>Hospitals With PICUs, n (%)</th>
<th>Change in PICUs, %a</th>
<th>Pediatric Beds</th>
<th>Change in Pediatric Beds, %a</th>
<th>Total Change in PICU Beds/PICU Beds, %a</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>4585</td>
<td>1753 (38.2)</td>
<td>0</td>
<td>358 (7.8)</td>
<td>0</td>
<td>31 171</td>
<td>0</td>
<td>4646 (0)</td>
</tr>
<tr>
<td>2009</td>
<td>4581</td>
<td>1733 (37.8)</td>
<td>−1.1</td>
<td>352 (7.7)</td>
<td>−1.7</td>
<td>31 043</td>
<td>−0.4</td>
<td>4640 (−0.1)</td>
</tr>
<tr>
<td>2010</td>
<td>4571</td>
<td>1708 (37.4)</td>
<td>−2.6</td>
<td>356 (7.8)</td>
<td>−0.6</td>
<td>31 156</td>
<td>0</td>
<td>4823 (3.8)</td>
</tr>
<tr>
<td>2011</td>
<td>4584</td>
<td>1681 (37.1)</td>
<td>−3.5</td>
<td>357 (7.8)</td>
<td>−0.3</td>
<td>30 759</td>
<td>−1.3</td>
<td>4840 (−4.2)</td>
</tr>
<tr>
<td>2012</td>
<td>4551</td>
<td>1650 (36.3)</td>
<td>−5.9</td>
<td>357 (7.8)</td>
<td>−0.3</td>
<td>30 269</td>
<td>−2.8</td>
<td>4858 (4.6)</td>
</tr>
<tr>
<td>2013</td>
<td>4538</td>
<td>1619 (35.7)</td>
<td>−7.6</td>
<td>354 (7.8)</td>
<td>−1.1</td>
<td>28 855</td>
<td>−3.9</td>
<td>4879 (5.0)</td>
</tr>
<tr>
<td>2014</td>
<td>4507</td>
<td>1575 (34.9)</td>
<td>−10.2</td>
<td>352 (7.8)</td>
<td>−1.7</td>
<td>29 213</td>
<td>−6.3</td>
<td>5007 (7.8)</td>
</tr>
<tr>
<td>2015</td>
<td>4483</td>
<td>1541 (34.4)</td>
<td>−12.1</td>
<td>351 (7.8)</td>
<td>−2.0</td>
<td>28 757</td>
<td>−7.7</td>
<td>5015 (7.9)</td>
</tr>
<tr>
<td>2016</td>
<td>4477</td>
<td>1508 (33.7)</td>
<td>−14.0</td>
<td>360 (8.0)</td>
<td>0.6</td>
<td>28 388</td>
<td>−8.9</td>
<td>5062 (9.0)</td>
</tr>
<tr>
<td>2017</td>
<td>4461</td>
<td>1455 (32.6)</td>
<td>−17.0</td>
<td>360 (8.1)</td>
<td>0.8</td>
<td>27 773</td>
<td>−10.9</td>
<td>5249 (13.0)</td>
</tr>
<tr>
<td>2018</td>
<td>4421</td>
<td>1418 (32.1)</td>
<td>−19.1</td>
<td>349 (7.9)</td>
<td>−2.5</td>
<td>27 496</td>
<td>−11.8</td>
<td>5388 (16.0)</td>
</tr>
</tbody>
</table>

a Change from baseline year of 2008.
>20 miles for 1.2 million children, >50 miles for 506,948 children, and >100 miles for 138,101 children. The percentage of children whose nearest hospital contained a pediatric inpatient unit decreased from 51.6% to 41.7%.

Median statewide pediatric inpatient unit beds per capita decreased 13.6% from 428 beds per million children (interquartile range [IQR] 356–487) to 370 beds per million children (IQR 316–445; \( P = .03 \)). Pediatric inpatient unit beds per capita decreased for 40 of 50 states by 2018 (Supplemental Fig 4).

**Pediatric Inpatient Unit Closures**
On average, 60.0 pediatric inpatient unit closures and 28.8 openings occurred each year (Supplemental Fig 5). Most closures (516 of 540; 95.7%)
and openings (244 of 259; 94.2%) were due to closure or opening of the pediatric inpatient unit only rather than the whole hospital. Time to closure was associated with lower pediatric bed volume and absence of a PICU (Table 2). Nonteaching status, rural location, lower Medicaid use quartile, and designation as critical access hospital or sole community hospital had univariable associations with time to closure but were not independently associated.

**Sensitivity Analyses**

Of analyzed hospitals, 56.7% provided complete pediatric inpatient unit bed counts each year they were open. A total of 8089 of 49739 (16.3%) pediatric inpatient unit bed count observations were imputed. Of these, 2315 (28.6%) were strictly imputed (ie, reported bed count was the same before and after the imputed interval). Teaching hospitals, nonprofit owned, higher profit margin, lower Medicaid use, higher total hospital capacity, urban-located, children’s hospitals, and those that ever had pediatric beds were more likely to have complete data (Supplemental Table 6). Trends in the prevalence of pediatric inpatient units were not significantly different from our main estimates when using different imputation methods (Supplemental Figs 6 and 7).

**DISCUSSION**

From 2008 to 2018, both pediatric inpatient units and pediatric

![Figure 2](image-url)

**FIGURE 2**

Change in distance to pediatric inpatient units by urbanicity. Change in distance to the nearest pediatric inpatient unit from baseline is shown for each year of the study for children living in urban, micropolitan, and rural areas. Approximately one-quarter of all children experienced an increase in distance to the nearest pediatric inpatient unit by the end of the study period. Children living in micropolitan or rural locations experienced larger changes in distance than those living in urban areas.
inpatient unit beds decreased. By contrast, pediatric inpatient unit beds and PICU beds within children’s hospitals expanded, thereby consolidating beds to a smaller number of centers. Pediatric inpatient unit and bed closures disproportionately occurred in rural areas and small centers. By 2018, there were large differences in the geographic availability of pediatric care and close to one-quarter of US children were farther from their closest pediatric inpatient unit. Although overall PICU bed capacity increased, children in many areas of the country continued to have poor access to PICUs. Children in rural areas, who already were vulnerable because of poorer access to pediatric services, experienced the greatest loss in inpatient access.

There are a number of potential reasons for the decrease in overall pediatric inpatient unit capacity. First, pediatric hospitalizations decreased over the last decade, reducing demand for beds and providers, which may have resulted in declining bed supply. Matched declines in bed capacity and use in most states support this hypothesis. Although we did not determine if decreases in pediatric bed use led to declines in bed capacity or vice versa, the similarity in declines in most states is notable. Second, changes in payer mix with a higher percentage of inpatient stays covered by Medicaid rather than private insurance, may make pediatric inpatient units less profitable and therefore an attractive target for cuts. Third, the cost and staff to maintain a pediatric unit could be prohibitive. Pediatric units require specialized providers, who are already in short supply in rural and underserved areas and may be migrating to larger academic centers. Similarly, it may be costly for small hospitals to maintain the many sizes of pediatric equipment needed for children from infancy to adolescence. Finally, areas with multiple hospitals may experience unit closures due to competition and redundancy.

The increasing concentration of pediatric inpatient unit and PICU beds in children’s hospitals might be explained by several factors. As the complexity of pediatric inpatients has increased, demand for pediatric subspecialty services and PICU beds available at these centers may be growing. Patients with special needs may preferentially travel to children’s hospitals, shifting demand away from lower-volume hospitals. Changes in workforce, epidemiology of...
pediatric critical illness, and reimbursement of critical care may have contributed to the upward trend in PICU beds observed.41,42 Future detailed examination is needed to ascertain whether increased demand for pediatric hospitals has led to higher concentrations of patients in these institutions or whether decreases in general hospital bed capacity have driven patients to higher-volume hospitals.

As pediatric inpatient services become less available, critical shortages may appear. Rural areas are at highest risk of losing pediatric inpatient services: large geographic areas of the country have lost access to inpatient care, further contributing to concentration of pediatric services in large centers. This regionalization has benefits for children with medical complexity and those requiring surgical subspecialty care,43 but the effect on outcomes for all children is unclear. Regionalization may increase crowding at referral pediatric centers.44 As transfer distance grows, costs and delays for transfers will increase.45 Increases in distance to care lead to longer length of stay and increased mortality46,47 and also increase the risk of transport-related adverse events.48

Additionally, for patients of low socioeconomic status who may not have ready access to transportation, even small increases in distance to pediatric services may have a large impact on access.49 Further study of the association of patient outcomes with the observed decreases in bed capacity and the relationship between outcomes and distance traveled is needed. Currently, the United States is underprepared to adapt to volume surges in pediatric patients, and declining inpatient unit capacity may further impair the system’s ability to manage surges during a disaster or pandemic.12,13,50

### TABLE 2 Hospital Characteristics Associated With Time to Pediatric Inpatient Unit Closure

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Proportion With Pediatric Unit Closure (%)</th>
<th>Unadjusted P</th>
<th>Hazard Ratio (95% CI)</th>
<th>Adjusted P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teaching status</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonteaching</td>
<td>454 of 1547 (29.3)</td>
<td>Referent</td>
<td>Referent</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Teaching</td>
<td>54 of 348 (15.5)</td>
<td>1.09 (0.79 to 1.50)</td>
<td>Referent</td>
<td></td>
</tr>
<tr>
<td>Hospital ownership</td>
<td></td>
<td>.33</td>
<td>Referent</td>
<td>.60</td>
</tr>
<tr>
<td>For profit</td>
<td>57 of 222 (25.7)</td>
<td>Referent</td>
<td>Referent</td>
<td>.80</td>
</tr>
<tr>
<td>Government</td>
<td>112 of 375 (29.9)</td>
<td>1.09 (0.78 to 1.55)</td>
<td>Referent</td>
<td></td>
</tr>
<tr>
<td>Nonprofit</td>
<td>339 of 1298 (26.1)</td>
<td>1.04 (0.77 to 1.40)</td>
<td>Referent</td>
<td></td>
</tr>
<tr>
<td>Urbanicity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban</td>
<td>289 of 1288 (22.4)</td>
<td>Referent</td>
<td>Referent</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Micropolitan</td>
<td>107 of 335 (31.9)</td>
<td>0.95 (0.75 to 1.23)</td>
<td>Referent</td>
<td></td>
</tr>
<tr>
<td>Rural</td>
<td>112 of 270 (41.5)</td>
<td>1.10 (0.81 to 1.51)</td>
<td>Referent</td>
<td></td>
</tr>
<tr>
<td>Critical access hospital or sole community hospital</td>
<td></td>
<td>&lt;.001</td>
<td>Referent</td>
<td>Referent</td>
</tr>
<tr>
<td>No</td>
<td>339 of 1425 (23.8)</td>
<td>Referent</td>
<td>Referent</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Yes</td>
<td>169 of 470 (36.0)</td>
<td>1.00 (0.77 to 1.28)</td>
<td>Referent</td>
<td></td>
</tr>
<tr>
<td>DSH hospital</td>
<td></td>
<td>.001</td>
<td></td>
<td>.98</td>
</tr>
<tr>
<td>No</td>
<td>166 of 502 (33.1)</td>
<td>Referent</td>
<td>Referent</td>
<td>.49</td>
</tr>
<tr>
<td>Yes</td>
<td>334 of 1365 (24.5)</td>
<td>0.92 (0.72 to 1.17)</td>
<td>Referent</td>
<td></td>
</tr>
<tr>
<td>Profit margin quartile</td>
<td></td>
<td></td>
<td></td>
<td>.34</td>
</tr>
<tr>
<td>Lowest</td>
<td>142 of 486 (29.2)</td>
<td>Referent</td>
<td>Referent</td>
<td>.04</td>
</tr>
<tr>
<td>Second</td>
<td>122 of 453 (26.8)</td>
<td>0.77 (0.61 to 0.99)</td>
<td>Referent</td>
<td></td>
</tr>
<tr>
<td>Third</td>
<td>113 of 480 (23.5)</td>
<td>0.73 (0.57 to 0.94)</td>
<td>Referent</td>
<td></td>
</tr>
<tr>
<td>Highest</td>
<td>125 of 457 (27.4)</td>
<td>0.97 (0.75 to 1.24)</td>
<td>Referent</td>
<td></td>
</tr>
<tr>
<td>Medicaid use quartile</td>
<td></td>
<td>.006</td>
<td>Referent</td>
<td>Referent</td>
</tr>
<tr>
<td>Lowest (&lt;8.1%)</td>
<td>100 of 287 (34.6)</td>
<td>Referent</td>
<td>Referent</td>
<td>.84</td>
</tr>
<tr>
<td>Second (8.1%–14.6%)</td>
<td>135 of 493 (27.4)</td>
<td>0.97 (0.75 to 1.30)</td>
<td>Referent</td>
<td></td>
</tr>
<tr>
<td>Third (14.6%–22.4%)</td>
<td>145 of 576 (25.2)</td>
<td>1.00 (0.74 to 1.35)</td>
<td>Referent</td>
<td></td>
</tr>
<tr>
<td>Highest (&gt;22.4%)</td>
<td>128 of 539 (23.7)</td>
<td>1.06 (0.79 to 1.43)</td>
<td>Referent</td>
<td></td>
</tr>
<tr>
<td>Pediatric bed count quartile</td>
<td></td>
<td>&lt;.001</td>
<td></td>
<td>.69</td>
</tr>
<tr>
<td>Lowest (&lt;5 beds)</td>
<td>204 of 471 (43.3)</td>
<td>3.35 (2.29 to 4.90)</td>
<td>Referent</td>
<td></td>
</tr>
<tr>
<td>Second (5–10 beds)</td>
<td>150 of 480 (32.6)</td>
<td>2.32 (1.61 to 3.34)</td>
<td>Referent</td>
<td></td>
</tr>
<tr>
<td>Third (11–18 beds)</td>
<td>108 of 477 (22.6)</td>
<td>1.55 (1.07 to 2.24)</td>
<td>Referent</td>
<td></td>
</tr>
<tr>
<td>Highest (&gt;18 beds)</td>
<td>46 of 487 (8.4)</td>
<td>Referent</td>
<td>Referent</td>
<td>.02</td>
</tr>
<tr>
<td>Presence of PICU</td>
<td></td>
<td>&lt;.001</td>
<td></td>
<td>.004</td>
</tr>
<tr>
<td>PICU present</td>
<td>16 of 354 (4.5)</td>
<td>Referent</td>
<td>Referent</td>
<td></td>
</tr>
<tr>
<td>PICU absent</td>
<td>492 of 1541 (31.8)</td>
<td>4.62 (2.73 to 8.49)</td>
<td>Referent</td>
<td></td>
</tr>
<tr>
<td>Hospital type*</td>
<td></td>
<td>&lt;.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>General hospital</td>
<td>508 of 1834 (27.7)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Children's hospital</td>
<td>0 of 61 (0)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Hospital type not included in multivariable model.
New policy strategies could mitigate the effect of inpatient unit closures. First, designating key community centers as "pediatric critical access hospitals" with subsidies or higher reimbursement could encourage vulnerable pediatric centers to remain open. Second, combining pediatric emergency departments and inpatient units has revealed promise in consolidating pediatric resources, improving financial sustainability. Third, telehealth may be a less costly way to connect pediatric specialists and intensivists to community physicians to make transfer decisions or assist with care. Finally, attention to regional surge plans will be critical to avoid maldistribution of pediatric resources during a disaster.

There were several limitations to this study. First, the self-reported nature of the AHA survey may lead to miscounts of inpatient units in existence or misclassification of certain hospital characteristics. Second, imputation may have decreased the accuracy of bed estimates, although sensitivity analyses suggest that our conclusions would be unlikely to change. Finally, we were unable to account for observation stays replacing inpatient hospitalizations. In previous studies, researchers have found that pediatric observation stays are increasing, and there is mixed evidence on whether this is linked to decreasing hospitalizations. Observation stays can occur within an emergency department, observation unit, or inpatient unit, so the extent to which observation stays would use the beds counted in our analysis is unclear. As such, we do not believe changes in observation stays alone are likely to account for the significant trends we observed, although further study could illuminate the relationship between observation stays and demand for pediatric beds.

CONCLUSIONS
Pediatric inpatient unit capacity is decreasing and PICU capacity is increasing in the United States. Access to pediatric inpatient services is declining, and PICU beds are becoming more concentrated in children’s hospitals. Geographic differences in access to pediatric care are increasing.

ABBREVIATIONS
AHA: American Hospital Association
CI: confidence interval
DSH: disproportionate share hospital
IQR: interquartile range

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